

Claim Rejections

Claims 1, 2 and 8-27 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the Office Action states that independent claims 1, 9, 14 and 18 recites a process without any process step, and that a number of claims recite limitations without adequate antecedent basis. Claims 1, 9, 14 and 18 have been amended to include process steps described in the specification. Claims 8, 13, 17, 19, 22, 24, and 27 have been cancelled. Claims 1, 2, 9-12, 14-16, 18, 20, 21, 23, 25 and 26 have been amended to provide antecedent basis for claim limitations.

The Office Action states that claims are incomplete for omitting essential steps. Independent claims 1, 9, 14 and 18 have been amended to include the essential steps of the process. The office action states that "...in claims 23-27, it is not perfectly clear what the various acronyms refer to, or where the basis for such is found in the specification...". Claims 23-26 have been amended to correct a typographic error in one of the acronyms. All the acronyms are defined in the specification (page 1, lines 7-14).

The Office Action also states that "in claims 19-22, as well as all the claims generally, it is not clear what applicants intends for the starting materials or products." The present invention involves a (re)crystallization process. The (re)crystallization process is a process in which the chemical identity of the starting material is identical to the chemical identity of the final material. However, the material characteristics, such as morphology, sensitivity and stability, are changed under influence of the application of ultrasound vibration during the (re)crystallization process. Independent claims 1, 8, 14 and 18 have been amended to better distinguish starting materials (the raw energetic materials) from the products (the crystalline energetic materials), and to make it obvious that the starting material is not identical to the product (having improved stability and/or decreased sensitivity). It should be noted that the energetic materials and explosives, as mentioned in the specification, are all pure chemical compounds and are not explosive compositions such as C4. C4 is not a material on which this invention is applicable.

Claims 1, 2 and 8-27 are rejected under 35 U.S.C. § 101 because the claimed recitation of a use, e.g., "process for the production" without setting forth any steps involved in the process, results in an improper definition of a process. The claims have been amended to include steps of the process. The Office Action also states that "the claims read on a process that goes through some method or procedure, which ends up with the precise starting material. Such a process fails to comply with the statutory requirement that the process be useful. Applicants respectfully submit that the claimed crystallisation process with ultrasonic vibration produces crystalline energetic materials having improved stability and/or decreased sensitivity, as shown in Examples 1 and 2. It is thus obvious that the product of the claimed process has properties superior to the starting material, and that the claimed process is useful since the improved stability and decreased sensitivity are much desired features for energetic materials.

Claims 1, 2 and 8-27 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,833,891 to Subramaniam et al. ("Subramaniam") in view of U.S. Patent No. 3,954,526 to Mangum et al. ("Mangum"), U.S. Patent No. 5,020,731 to Somoza et al. ("Somoza I"), and U.S. Patent No. 5,279,492 to Somoza et al. ("Somoza II").

The present invention discloses a crystallisation process with ultrasonic vibration that produces crystalline energetic materials with increased stability and decreased sensitivity.

Subramaniam discloses methods and apparatus for particle precipitation and coating using near- or supercritical fluid conditions. It teaches the use of ultrasonic waves to break up the dispersion into extremely small droplets and cause precipitation of very small particles. However, Subramaniam focuses on the reduction of particle sizes during the precipitation. It does not disclose that this procedure can be used to increase stability and decrease sensitivity of energetic materials. In addition, Subramaniam uses a supercritical anti-solvent which is not required by the present invention.

Mangnum discloses a method for making coated ultra-fine ammonium perchlorate particles without grinding. The method utilizes a precipitation procedure with ultrasonic vibrations. The major objective of Mangnum's invention is to produce ultra-fine ammonium perchlorate particles without mechanical grinding operations so that the risk of explosion during the refining process is minimized. Mangnum does not teach that ultrasonic vibration is essential and, more importantly, it does not mention nor suggest that the application of ultrasonic vibration improves the stability and/or sensitivity of the resulting ammonium perchlorate particles.

Somoza I discloses a method for removing occluded acidity from unrecrystallized explosive materials. The method involves an ultrasonic grinding step, which is a process completely different from the precipitation and recrystallisation. When applying ultrasonic vibration during grinding, the ultrasonic energy is directed towards the solid particulates which apparently breaks under influence of the ultrasonic energy. When applying ultrasonic vibration during precipitation and recrystallisation, the ultrasonic energy is directed towards the crystallizing mixture where it influences nucleation and crystal growth of the solid particulates. Therefore, it would not be obvious for a person skilled in the art to combine Somoza I with Subramaniam at the time of the invention. Furthermore, Somoza I does not teach or suggest anything about the stability or sensitivity of the explosive materials prepared by the ultrasonic grinding procedure.

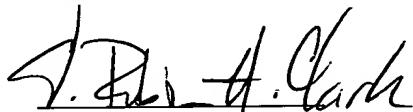
Somoza II discloses a process for reducing the particle size of particulate crystalline energetic materials by slurring the particulate energetic particles in an inert liquid in a high-pressure grinding chamber. Somoza II discloses that the sensitivity of a particulate energetic material is reduced when the particle size of the particulate energetic material is reduced. However, Somoza II does not show any evidence that the sensitivity of the particulate energetic material prepared by the claimed process is indeed reduced, nor does Somoza II disclose anything about the stability of the particulate energetic material. Furthermore, according to the present invention, there is no direct link between the particle morphology (aspect ratio and particle size are both morphology parameters) and the stability and sensitivity (page 3, lines 19-28).

In summary, none of the above-discussed patents, or a combination of them, discloses the unexpected features (i.e., the increased stability and decreased sensitivity) of the product produced by the present invention. Applicants respectfully request that the rejection of independent claims 1, 9, 14, and 18 be withdrawn and the claims allowed.

Applicants respectfully submit that dependent claims 2, 10-12, 15, 16, 20, 21, 23, 25, and 26 are patentable for the reasons provided with respect to claims 1, 9, 14, and 18, and because they define additional combinations of features not found in or suggested by the cited references.

In view of the foregoing remarks, favorable reconsideration of all pending claims is requested. Applicants respectfully submit that this application is in condition for allowance and request that a notice of allowance be issued. Should the Examiner believe that a conference would expedite the prosecution of this application or further clarify the issues, the Examiner is encouraged to contact Applicants' attorney at the telephone number listed below.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

1. (Amended) A [P]process for the production of crystalline energetic materials having improved stability and/or decreased sensitivity by crystallisation of raw energetic materials, comprising:

preparing a crystallising mixture containing the raw energetic materials; and
subjecting the crystallising mixture to [with] ultrasonic vibration [having a frequency of between 10 and 100 kHz] during crystallisation, and
harvesting the crystalline energetic materials,
wherein the ultrasonic vibration has a frequency of between 10 and 100 kHz, and results in a zone of ultrasonic vibration in the crystallising mixture.
2. (Amended) The [P]process [according to] of claim 1, wherein the crystallising mixture is stirred during the crystallisation.
8. (Cancelled) Process according to claim 1, wherein the crystallising mixture is transported continuously through the zone of ultrasonic vibration.
9. (Amended) A [P]process for the production of crystalline energetic materials having improved stability and/or decreased sensitivity by crystallisation of [the]raw energetic materials, comprising:

preparing a crystallising mixture containing the raw energetic materials; and
subjecting the crystallising mixture to [with] ultrasonic vibration [having a frequency of between 10 and 100 kHz] during crystallisation, and
harvesting the crystalline energetic materials,
wherein the ultrasonic vibration has a frequency of between 10 and 100 kHz, and results in a zone of ultrasonic vibration in the crystallising mixture;
wherein the crystallising mixture is stirred during crystallisation[;], and is passing through the zone of ultrasonic vibration continuously.

[wherein the crystallising mixture is transported continuously through the zone of ultrasonic vibration.]

10. (Amended) The [P]process [according to]of claim 9, wherein the temperature during [re]crystalli[z]sation is between 15 and 75°C.

11. (Amended) The [P]process [according to]of claim 1, wherein the temperature during [re]crystalli[z]sation is between 15 and 75°C.

12. (Amended) The [P]process [according to]of claim 2, wherein the temperature during [re]crystalli[z]sation is between 15 and 75°C.

13. (Cancelled) Process according to claim 10, wherein the ultrasonic vibration is generated using an ultrasonic probe, the amplitude thereof being between 0.4 and 10 μm .

14. (Amended) A [P]process for the production of crystalline energetic materials having improved stability and/or decreased sensitivity by crystallisation of [the]raw energetic materials, comprising:

preparing a crystallising mixture containing the raw energetic materials; and
subjecting the crystallising mixture to [with] ultrasonic vibration [having a frequency of
between 10 and 100 kHz] during crystallisation, and
harvesting the crystalline energetic materials,
wherein the ultrasonic vibration has a frequency of between 10 and 100 kHz, and results
in a zone of ultrasonic vibration in the crystallising mixture,
wherein the crystallising mixture is stirred during crystallisation[, and is passing
through the zone of ultrasonic vibration continuously,
wherein the temperature during [re]crystallisation is between 15 and 75°C,
wherein the ultrasonic vibration is generated using an ultrasonic probe[,] having an [the]
amplitude [thereof being] between 0.4 and 10 μm .

15. (Amended) The [P]process [according to]of claim 1, wherein the ultrasonic vibration is generated using an ultrasonic probe[,]having an [the] amplitude [thereof being]of between 0.4 and 10 μm .

16. (Amended) The [P]process [according to]of claim 2, wherein the ultrasonic vibration is generated using an ultrasonic probe[,]having an [the] amplitude [thereof being]of between 0.4 and 10 μm .

17. (Cancelled) Process according to claim 8, wherein the ultrasonic vibration is generated using an ultrasonic probe, the amplitude thereof being between 0.4 and 10 μm .

18. (Amended) A [P]process for the production of crystalline energetic materials having improved stability and/or decreased sensitivity by crystallisation of [the]raw energetic materials, comprising:

subjecting the crystallising mixture to [with] ultrasonic vibration [having a frequency of between 10 and 100 kHz] during crystallisation, and

harvesting the crystalline energetic materials,

wherein the ultrasonic vibration has a frequency of between 10 and 100 kHz, and results in a zone of ultrasonic vibration in the crystallising mixture,

wherein the crystallising mixture is stirred during crystallisation[;], and is passing through the zone of ultrasonic vibration continuously,

wherein the temperature during [re]crystallisation is between 15 and 75°C,

wherein the ultrasonic vibration is generated using an ultrasonic probe[,] having an [the] amplitude [thereof being] between 0.4 and 10 μm ,

wherein the raw energetic materials are selected from [the]a group consisting of explosives and high energy oxidisers.

19. (Cancelled) Process according to claim 18, wherein the energetic materials are selected from the group of explosives and high energy oxidisers.
20. (Amended) The [P]process [according to]of claim 1, wherein the raw energetic materials are selected from [the]a group consisting of explosives and high energy oxidisers.
21. (Amended) The [P]process [according to]of claim 2, wherein the raw energetic materials are selected from [the]a group consisting of explosives and high energy oxidisers.
22. (Cancelled) Process according to claim 8, wherein the energetic materials are selected from the group of explosives and high energy oxidisers.
23. (Amended) The [P]process [according to]of claim 18, wherein the [said] raw energetic materials are selected from [the]a group consisting of hydrazinium nitroformate, C[1]L-20, ADN, AP, RDX, HMX and PETN.
24. (Cancelled) Process according to claim 19, wherein the said energetic materials are selected from the group consisting of hydrazinium nitroformate, C120, ADN, AP, RDX, HMX and PETN.
25. (Amended) The [P]process [according to]of claim 1, wherein the said energetic materials are selected from [the]a group consisting of hydrazinium nitroformate, C[1]L-20, ADN, AP, RDX, HMX and PETN.
26. (Amended) The [P]process [according to]of claim 2, wherein the said energetic materials are selected from [the]a group consisting of hydrazinium nitroformate, C[1]L-20, ADN, AP, RDX, HMX and PETN.
27. (Cancelled) Process according to claim 8, wherein the said energetic materials are

selected from the group consisting of hydrazinium nitroformate, C120, ADN, AP, RDX, HMX and PETN.

PENDING CLAIMS

1. (Amended) A process for the production of crystalline energetic materials having improved stability and/or decreased sensitivity by crystallisation of raw energetic materials, comprising:
 - preparing a crystallising mixture containing the raw energetic materials;
 - subjecting the crystallising mixture to ultrasonic vibration during crystallization; and
 - harvesting the crystalline energetic materials,

wherein the ultrasonic vibration has a frequency of between 10 and 100 kHz, and results in a zone of ultrasonic vibration in the crystallising mixture.
2. (Amended) The process of claim 1, wherein the crystallising mixture is stirred during crystallisation.
9. (Amended) A process for the production of crystalline energetic materials having improved stability and/or decreased sensitivity by crystallisation of raw energetic materials, comprising:
 - preparing a crystallising mixture containing the raw energetic materials; and
 - subjecting the crystallising mixture to ultrasonic vibration during crystallization; and
 - harvesting the crystalline energetic materials,

wherein the ultrasonic vibration has a frequency of between 10 and 100 kHz, and results in a zone of ultrasonic vibration in the crystallising mixture,

wherein the crystallising mixture is stirred during crystallisation, and is passing through the zone of ultrasonic vibration continuously.
10. (Amended) The process of claim 9, wherein the temperature during crystallisation is between 15 and 75°C.

11. (Amended) The process of claim 1, wherein the temperature during crystallisation is between 15 and 75°C.

12. (Amended) The process of claim 2, wherein the temperature during crystallisation is between 15 and 75°C.

14. (Amended) A process for the production of crystalline energetic materials having improved stability and/or decreased sensitivity by crystallisation of raw energetic materials, comprising:

preparing a crystallising mixture containing the raw energetic materials; and
subjecting the crystallising mixture to ultrasonic vibration during crystallization; and
harvesting the crystalline energetic materials,

wherein the ultrasonic vibration has a frequency of between 10 and 100 kHz, and results in a zone of ultrasonic vibration in the crystallising mixture,

wherein the crystallising mixture is stirred during crystallisation, and is passing through the zone of ultrasonic vibration continuously,

wherein the temperature during crystallisation is between 15 and 75°C,

wherein the ultrasonic vibration is generated using an ultrasonic probe having an amplitude between 0.4 and 10 µm.

15. (Amended) The process of claim 1, wherein the ultrasonic vibration is generated using an ultrasonic probe having an amplitude of between 0.4 and 10 µm.

16. (Amended) The process of claim 2, wherein the ultrasonic vibration is generated using an ultrasonic probe having an amplitude of between 0.4 and 10 µm.

18. (Amended) A process for the production of crystalline energetic materials having improved stability and/or decreased sensitivity by crystallisation of raw energetic materials, comprising:

preparing a crystallising mixture containing the raw energetic materials; and

subjecting the crystallising mixture to ultrasonic vibration during crystallization; and harvesting the crystalline energetic materials,

wherein the ultrasonic vibration has a frequency of between 10 and 100 kHz, and results in a zone of ultrasonic vibration in the crystallising mixture,

wherein the crystallising mixture is stirred during crystallisation, and is passing through the zone of ultrasonic vibration continuously,

wherein the temperature during crystallisation is between 15 and 75°C,

wherein the ultrasonic vibration is generated using an ultrasonic probe having an amplitude between 0.4 and 10 μ m,

wherein the raw energetic materials are selected from a group consisting of explosives and high energy oxidisers.

20. (Amended) The process of claim 1, wherein the raw energetic materials are selected from a group consisting of explosives and high energy oxidisers.

21. (Amended) The process of claim 2, wherein the raw energetic materials are selected from a group consisting of explosives and high energy oxidisers.

23. (Amended) The process of claim 18, wherein the raw energetic materials are selected from a group consisting of hydrazinium nitroformate, CL-20, ADN, AP, RDX, HMX and PETN.

25. (Amended) The process of claim 1, wherein the said energetic materials are selected from a group consisting of hydrazinium nitroformate, CL-20, ADN, AP, RDX, HMX and PETN.

26. (Amended) The process of claim 2, wherein the said energetic materials are selected from a group consisting of hydrazinium nitroformate, CL-20, ADN, AP, RDX, HMX and PETN.